IPL Project Annual Report Form 2013
1 January 2013 to 31 December 2013

1. Project Title

Landslide susceptibility and landslide hazard zonation in volcanic terrains using Geographic Information System (GIS): A case study in the Río Chiquito-barranca Del Muerto watershed; Pico de Orizaba volcano, México

2. Main Project Fields

Hazard Mapping, Vulnerability and Risk Assessment

3. Name of Project leader

Dr. Gabriel Legorreta Paulín

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Core members of the Project: Names/Affiliations: (4 individuals maximum)

Dra. Irasema Alcantara Ayala / Instituto de Geografía, UNAM
Dr. José Juan Zamorano Orózco / Instituto de Geografía, UNAM
Dr. José Lugo Hubp / Instituto de Geografía, UNAM

4. Objectives: The objectives of this project are (1) Prepare a landslide inventory map and landslide susceptibility zonation for the study area in GIS. (2) Evaluate the performance of GIS-based slope-stability models to select the model that meets criteria for scientific accuracy, technical accessibility, and applicability. (3) Develop a method (protocol) for hazard assessment of potentially unstable landforms with the designated mapping methodology for volcanic terrains.

5. Study Area: Río Chiquito-barranca Del Muerto watershed at Pico de Orizaba volcano, México

6. Project Duration 3 years

7. Report
1) Progress in the project: (30 lines maximum)

During the third year information was collected to provide context and to establish a generalized characterization of landforms within the watershed. For the study area, landforms and landslide distribution were ascertained through a landslide inventory map created from multi-temporal aerial photographs, field investigations and an adaptation of the Landslide Hazard Zonation Protocol of the Washington State Department of Natural Resources, Forest Practices Division, in a GIS-based technology. This analysis divided the watershed into 12 mass-wasting landforms that were assigned slope-stability hazard ratings from low to very high. The overall hazard rating for this watershed was found very high. The GIS overlay of landforms versus landslide inventory shows that landforms differ in their pattern of resistance to erosion processes and in the type of mass movement; these differences are due to their specific geologic and geomorphometric properties. It was found that almost 40% of the landslides had developed along inner gorges and non-rule-identified inner gorges, which cover only 10% of the study area. In these two landforms shallow undifferentiated landslides, debris flow, and debris landslides are the predominant mass wasting processes. Both landforms are prone more to landslides in the middle and lower portion of the watershed, where there are steep slopes, loose volcanic ash, pyroclastic flow deposits, and vulcanoclastic and sedimentary material. This finding is important in understanding the long-term evolution of the stream system on the southwestern flank of Pico de Orizaba, and may prove is useful in the quantification, assessment, and modeling of landslide volumes that occur continually in volcanic terrains. Also, during the third year, five sessions of field work was conducted in 2012 and 2013 along the main river for a transect of 40 km, ranging from 1260 m a.s.l. to 4710 m a.s.l. to obtain geotechnical sample data. Dr. Marcus Bursik; researcher from The State University of New York, University at Buffalo and UNAM’s students (2 master students and one PhD student) helped in planning and collecting samples of material involved in sliding processes found in the valley. In the laboratory, students have been working to calculate cohesion, internal friction angle, and infiltration. They have been trained in laboratory techniques to enhancing human and institutional capacities. The final findings will be presented in the 2013 ICL meeting at Japan and in the 3th world landslide Forum in Beijing, China to conclude the project.

2) Planned future activities or Statement of completion of the Project (15 lines maximum)

The project will conclude in November 2013 when the final result will be presented in the 2013 ICL meeting. Dissemination of our findings will be published in Zeitschrift für Geomorphologie, and also in the 3th world landslide Forum in Beijing, China. A new landslide project will be presented in the 2013 ICL meeting.

3) Beneficiaries of Project for Science, Education and/or Society (15 lines maximum)

By directly addressing the landslide mapping issues, local authorities such as the civil protection agencies of Puebla and Veracruz states and other governmental organizations will benefit for hazard mitigation and planning.
4) Results: (15 line maximum, e.g. publications)
   a) The findings were presented at the 10th Anniversary of ICL – January 2012, Kyoto, The title was Landslide distribution and volumes on the SW flank of Pico de Orizaba volcano, Mexico.
   c) A poster (“An overview of a GIS method for mapping landslides and assessing landslide hazards at the Río El Estado watershed, on the SW flank of Pico de Orizaba Volcano, Mexico.”) was presented at the American Geophysical Union fall meeting San Francisco, California, USA. December 3 - 7 2012.
   d) Two papers: 1) “Metodología para la elaboración de cartografía de procesos gravitacionales y la evaluación de la susceptibilidad de deslizamientos: Caso de estudio Río El Estado en el flanco SW del Volcán Pico de Orizaba, México” and 2) “Mapping landforms and assessing landslide hazards on the SW flank of Pico de Orizaba volcano, Puebla-Veracruz, Mexico.” were sent for publication in the boletín of the Instituto de Geología, UNAM and in Zeitschrift für Geomorphologie Journal respectively.
   e) A poster and a talk will be presented in the 3th world landslide Forum in Beijing, China.

Note:

1) If you will change items 1)-6) from the proposal, please write the revised content in Red.

2) Please fill and submit this form by 30 March 2013 to the IPL and WCoE Network Committee: ipl-wcoe@iclhq.org

3) IPL-172, 173, 175 are new, and 2011 reports are not necessary to submit, because it is very short activity period